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Dr. Hohn of the Department of Physiology and Pharmacology at the University of Alberta, has made a number of ornithological expeditions to the Arctic. He restricts the scope of this article to matters affecting arctic birds in general; detailed accounts of particular species will be found in "Arctic Birds of Canada" by L. L. Snyder, reviewed in the winter 1957 "Beaver."

BY E. O. HOHN

Birds in the Arctic

R. T. Congdon *A rare species, the Hudsonian godwit. It is larger than a pigeon and its long bill tilts slightly upwards.*

Ralph S. Palmer *Hudsonian curlew, or whimbrel, approaching its nest. The long downward-curved bill distinguishes this shorebird.*

THE Arctic as a life zone is defined not as the area north of the arctic circle, but as that beyond the limit of trees. In Canada, this zone extends well to the south of the arctic circle along the shores of Hudson Bay. On the other hand, forested country with a decidedly non-arctic bird life also extends well north of the circle along the Mackenzie Valley. If one excludes a number of species of birds which nest some way into the barrens but belong in the main to the northern wooded country, the list of birds found in the Canadian Arctic is a fairly short one. It can be divided into three sections.

(1) Birds likely to occur anywhere in arctic Canada: Common loon, arctic loon, red-throated loon, whistling swan, Canada goose, Brant goose (with a different race or subspecies in the east and west), snow and blue goose (the blue is now considered to be a colour phase of the snow goose, not a distinct species), pintail, old squaw, common eider, king eider, red-breasted merganser, rough-legged hawk, golden eagle, gyrfalcon, peregrine falcon (or duck hawk), willow ptarmigan, rock ptarmigan, sandhill crane (or little brown crane), semipalmated plover, golden plover, black-bellied plover, ruddy turnstone, Hudsonian curlew (or whimbrel), knot, pectoral sandpiper, red-backed sandpiper (or dunlin), Baird's sandpiper, semipalmated sandpiper, sanderling, red

Baird's sandpiper with chick. This sandpiper is little larger than a sparrow.

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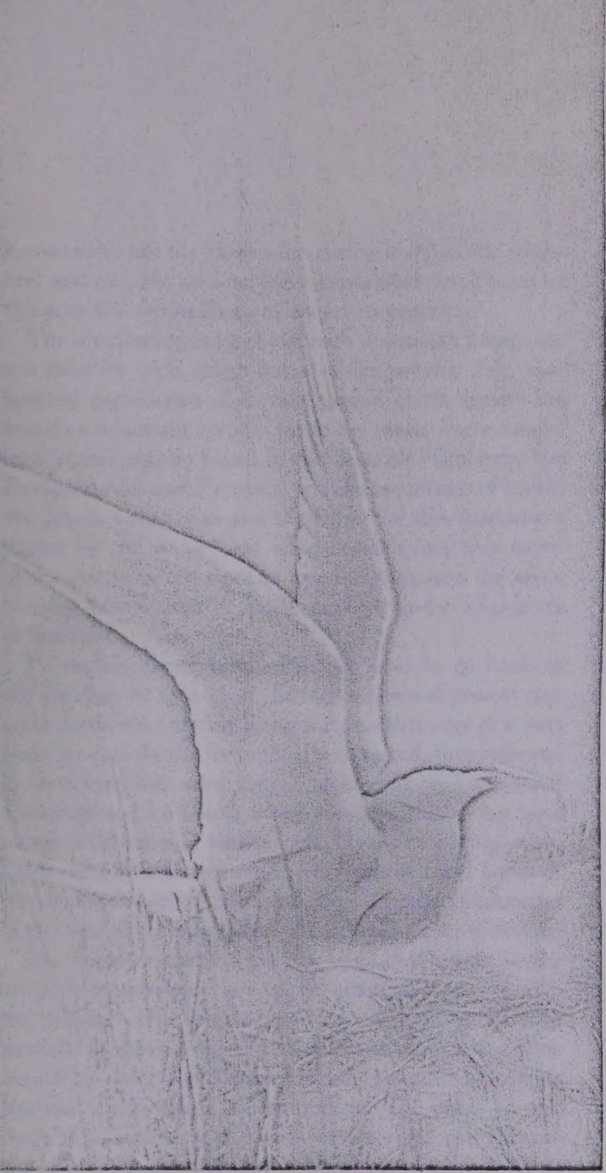


Arctic tern alighting by its young. This bird makes one of the longest migrations known, wintering in Antarctic regions.
R. T. Congdon

and northern phalarope, pomarine, long-tailed, and parasitic jaeger, glaucous gull, herring gull, Sabine's gull, arctic tern, snowy owl, short-eared owl, horned lark, raven, wheatear, water (or American) pipit, hoary and common redpoll, Savannah sparrow, tree sparrow, white-crowned sparrow, Lapland longspur, snow bunting.

(2) Species confined to the western arctic:
Yellow-billed loon, white-fronted goose, Ross's goose, stilt sandpiper, buff-breasted sandpiper, Hudsonian godwit.

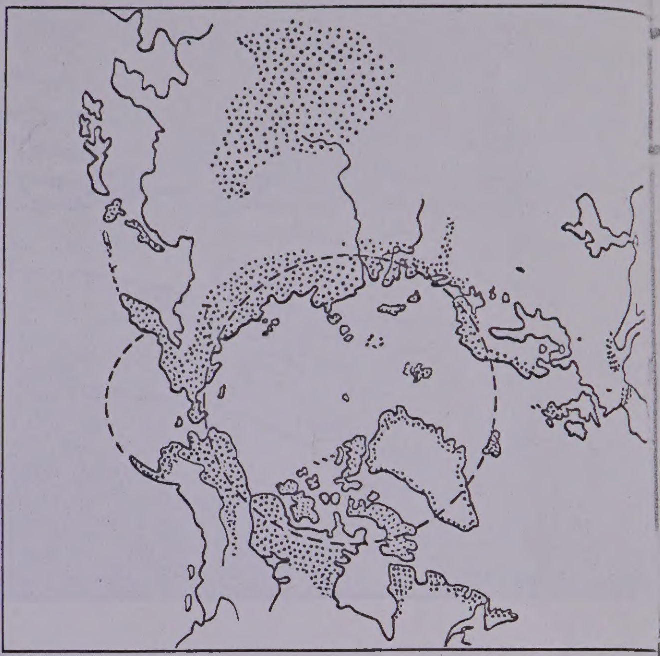
(3) Species confined to the eastern arctic:
Fulmar, harlequin duck, purple sandpiper, Iceland gull, kittiwake, thick-billed murre, dovekie, black guillemot.

The vast majority of these birds avoid the challenge of the arctic winter by migration and the proportion of resident species is very much smaller than farther south. The regular residents are in fact only the snowy owl, gyrfalcon, raven, the two ptarmigans, and the three eastern auks—thick-billed murre, dovekie, and black guillemot.

Towards the north pole, the continents of Eurasia and North America approach one another fairly closely and this no doubt explains the fact that something like two-thirds of our arctic birds are found also in the Old World and are in fact circumpolar in distribution. This is well illustrated by the world distribution of the rock ptarmigan shown in the sketch map. The wide distribution of many of our arctic birds is to some extent obscured by the use of different names for the same bird on the two sides of the Atlantic, thus the loons (all circumpolar except the yellow-billed) are called divers in Britain; the jaegers are there

A downy young snowy owl. This large owl is one of the most widespread of Canadian arctic birds and one of the few species that normally winter in the Arctic.
L. A. Learmonth

Sketch map showing world distribution of rock ptarmigan.



known as skuas, the Hudsonian curlew is called the whimbrel and the red and northern phalaropes are known as the grey and red-necked phalaropes respectively.

The distribution map of the rock ptarmigan brings out not only its wide range but also the peculiar fact that isolated populations of certain typical arctic species are found on mountain systems far to the south. For example, rock ptarmigan are found in the Scottish Highlands, the European Alps and Pyrenees, and the mountains of northern Japan. Other examples of this sort of distribution are shown by the water pipit which nests a long way south of the Arctic in the Rockies and the Alps, and the snow bunting which nests in small numbers in the Highlands of Scotland.

To explain these peculiarities we have to go back to the Ice Age. At that time, the fore-runners of present day arctic birds were nesting along the southern edge of a vast polar ice-cap. As the ice gradually retreated, they followed it northward but some instead of keeping with the main mass followed ice sheets which slowly withdrew up local mountain systems where the ice finally dwindled to glaciers. Confirming this theory are the findings of fossil bones of certain typical arctic birds in ice-age deposits of countries in the temperate zone where these birds are now extinct.

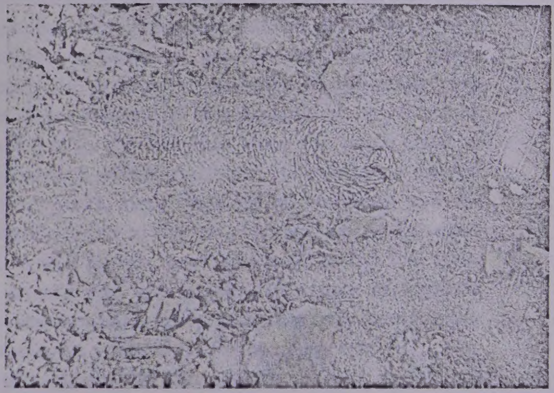
One wonders whether the few birds that winter in the Arctic have developed any special adaptation to cope with the climate. The various ways in which warm blooded animals in general respond to cold weather can be illustrated by using our thermostatically controlled domestic heating arrangements as an analogy. The onset of cold leads to a narrowing of blood vessels which run beneath the skin (and in mammals, to an arrest of sweating). At the same time feathers or fur are erected, which thickens the layer of still air entrapped in these structures. Since air is a poor conductor the effect is to increase the insulation provided by the animal's covering. This corresponds to the putting up of storm windows in a house.

Greater cold cannot be dealt with merely by cutting down on heat loss and increasing insulation, so the animal must now increase its heat production as well. This would correspond to the turning on of the domestic furnace and like the latter it entails an increased consumption of fuel which in the animal economy is food. The temperature which, to continue the analogy, starts up the furnace, is much lower in arctic animals than in those from temperate or tropical areas. This low setting of the "thermostat" controlling extra heat production is actually the chief adaptation to a cold climate so far discovered in arctic birds and mammals. Because of it arctic animals do not need to eat more merely to keep warm, unless extremely low temperatures are reached. It also implies that the covering layer of arctic animals has a much higher heat insulating value than that of more southerly animals.

There is further a seasonal variation in the insulation value of animal coats. In the fur bearers it is very evident in the difference between winter and summer pelts. Birds show an increased number of feathers in their winter plumages, and in the ptarmigans the toes which are bare in summer become thickly feathered right up to the claws in the cold season.

In a considerable number of birds and mammals which nest over a wide range of latitude, individuals from the northern part of the range average larger than those from the southern extremes. This is well illustrated in the horned lark; arctic specimens have wings about 110 millimetres long whereas those of southern California have wings only 99 millimetres long. This increase in size of northern birds is apparently also an adaptation to the cold. Heat loss takes place on the surface. Now it is a geometrical fact that in a small body there is more surface relative to volume than in a large one. Since in a small bird there is more surface per volume of tissue, where heat is produced, than in a larger one, the tissues of the smaller bird have to be more active. This means the small bird has to eat more per unit of body weight than a larger one. In a cold environment, unless food is always present in excess, sur-

Rock ptarmigan in white winter plumage. These fowl-like birds are winter residents in the Arctic. *P. Paulsson*

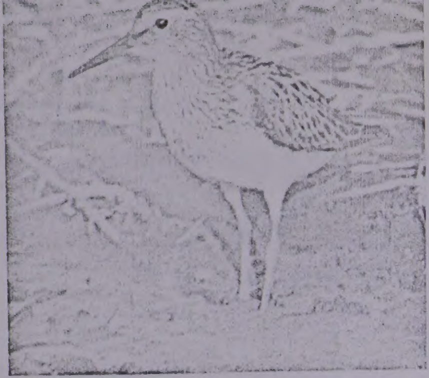


On its nest, a depression in the stony ground, the ptarmigan in summer plumage is inconspicuous. *Martin*

vival of larger individuals will be favoured. In the Arctic, two thirds of the bird species are pigeon size or larger; farther south birds of this size amount to less than a third of the total species list. Although most arctic birds which also range well into the temperate zone follow this rule, there are some notable exceptions. In the Canada goose, for example, the largest races are those breeding in the southern part of its range whereas the arctic races are the smallest ones.

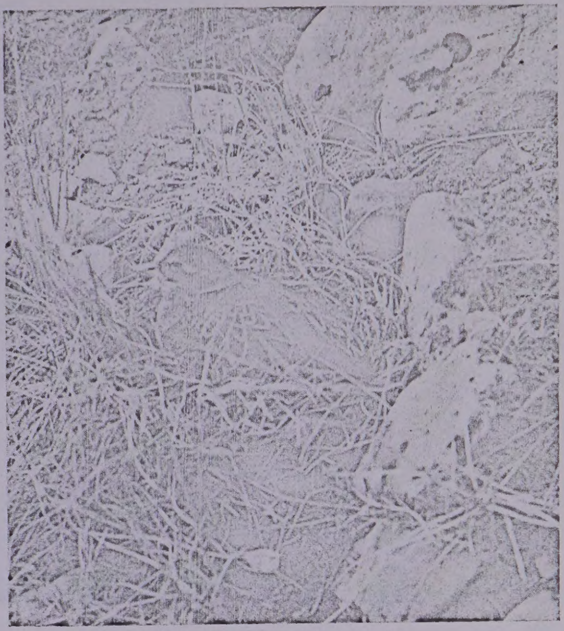
The cyclical fluctuations of lemming populations and the secondary cycles of the fur bearers which feed principally on lemmings are well known. It is less well known that a number of arctic birds are also affected by the lemming cycles. Birds which fluctuate with the lemmings are the short-eared and snowy owl, the rough-legged hawk, and the pomarine and long-tailed jaegers, which all prey on lemmings. These birds not only increase in numbers in localities where lemmings are at a peak but they lay larger clutches of eggs in peak years. In years of low lemming population many of them do not nest at all or they lay less than the average number of eggs. A study of the effect of lemming numbers on some of their bird predators has recently been made in the Point Barrow area of Alaska.

Studies in the Churchill area have shown similar fluctuations in the local population of snowy and short-eared owls and rough-legged hawks with the local density of collared lemmings. It has even been possible to correlate the invasions of snowy owls into New England, south of the owl's normal winter range, with the lemming cycle at Churchill over a fourteen year period. Snowy owl invasions were found to coincide with the lemming crashes farther north. It has been mentioned that this owl is one of the few birds of which a great proportion normally winter in the far north. When lemmings in the owls' breeding range are at a minimum almost all the owls are forced to emigrate in the winter. This brings about a temporary enlargement



The pectoral sandpiper breeds across the Canadian Arctic west of Hudson Bay and migrates to South America to winter.
E. O. Hohn

An old-squaw duck on its nest which is made of grasses and other small plants and lined with down.
W. F. Joss



of the wintering area to regions farther south than those regularly visited.

Willow and rock ptarmigan also show marked fluctuations in population. There is not enough information for Canada to indicate whether these fluctuations are regular or not but in Norway both ptarmigans are said to show regular four year peaks coinciding with the lemming peaks. In this instance, the connection between lemming and bird is an indirect one. Animals that prey on the ptarmigans—foxes, snowy owl, and the gyrfalcon—live mainly on lemmings when these are readily available. When lemmings decline, these predators are forced to look mainly to ptarmigans for their sustenance and this decreases ptarmigan numbers. As lemmings increase once more in subsequent years, the pressure of predation on the ptarmigans decreases. Some support for this explanation of ptarmigan cycles is found in the fact that along the north shore of the St. Lawrence, willow ptarmigan show ten year instead of four year peaks. Here there are no lemmings and the cycle is basically due to the ten year cycle of the snowshoe hare. As is well known, predators such as red fox, lynx, weasels, horned owl, and goshawk fluctuate in numbers with the snowshoe hares and presumably prey more heavily on ptarmigans in years when the hares are scarce.

A further element of irregularity in local polar bird populations results from late springs or inclement weather during the breeding season. There is, for example, a very large breeding colony of lesser snow geese in southwest Banks Island (*Beaver*, Summer 1954). In years of late springs, many of these geese do not reach the island at all but nest instead in the delta of the Anderson River and on the Cape Bathurst Peninsula over which they normally pass on their northward migration.

It is well established that there has been an improvement of the arctic climate in the last fifty or so years. This has had a definite effect on bird distribution. For example, the pintail and meadow pipit formerly merely known as accidental vagrants in Greenland now nest regularly in the southern part of that island. In addition, some of the birds characteristic of the high arctic region

Distraction display by a semipalmated plover. Adult birds perform in this way to decoy predators away from their young.

A horned lark, one of the few song birds of the Arctic.

E. O. Hohn

have stopped using the southern parts of their former breeding areas.

Such changes also appear to have taken place in Canada. Chief Factor Roderick MacFarlane who founded the Hudson's Bay Company trading post at Fort Anderson in 1861 and who incidentally was the first white man to explore the Anderson River in 1857, has left us a complete account of the bird life of that area in the 1860s. In 1955, I was able to spend the summer at the mouth of the Anderson. When comparing what I found with MacFarlane's account, it was clear that there had been a shift in the local bird life similar to that noted in Greenland. For example, MacFarlane found no duck hawks (peregrine falcons) north of latitude 68°. In 1955, they nested not only as far as Cape Bathurst, about 70°, but were known to be nesting even farther north in Banks Island. In the 1860s the willow ptarmigan was said to be scarce beyond the tree line, where I found it abundant. I also found the yellow warbler and the rusty blackbird nesting to about latitude 70°, whereas ninety years before these birds were unknown beyond the tree line. On the other hand, one looks in vain nowadays for some of the high arctic birds which MacFarlane found nesting and which now breed farther north.

No doubt such climatic changes occurred before arctic temperatures were recorded and northern and southern limits of breeding ranges in the Arctic have probably always been subject to change.

On the whole, birds are very sparsely distributed in arctic areas compared to the temperate zones. Local aggregations, where birds are really crowded, do occur in the nesting colonies of snow geese and in the breeding rookeries of some of the auks; a fairly rich and varied bird life is also found in certain of the deltas of major rivers and in favoured areas of coastal tundra.

Because of the almost complete absence of cover on the tundra birds can be seen for considerable distances, depending of course on the bird's size. Based on this fact, T. H. Manning has worked out a very simple technique for establishing arctic bird populations. A record is kept on all long walks of the number of birds of each species seen. The average number of each species per hour of walking is then calculated. On the assumption that one walks in tundra country at about two miles per hour, and can see large birds up to a quarter of a mile on either side, the average number seen per hour is the number per square mile. For the smaller birds, the number per hour is multiplied by a factor depending on the size of the bird. For the smallest birds the factor is ten. Using this technique, the total summer bird population of Banks Island, 24,600 square miles in area, was estimated at 1,750,000. This can be compared to an estimate of 80,000,000 breeding birds for England and Wales, an area a little over twice the size of Banks Island (actually 58,340 square miles) made some years ago. ◆

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